THE ANOPHELES MOSQUITO IN RELATION TO MALARIA AND AGRICULTURE *

By C. E. Wilson

In considering the recent development, as brought to light, in the past few years on the role of insects as transmitters of disease, I think best to give very briefly a general history of this development.

From all appearances it is natural to suppose that insect transmission of disease has come abruptly into prominence; this, however, is not the facts, for at no time and in no case have great movements or great discoveries been produced suddenly. Centuries ago there was suggested the possibility that insects were associated with the cause of disease and through these early suggestions we have obtained our present knowledge.

Perhaps one of the earliest references to this subject is by an Italian physician, Mercurioles (1530-1607). This was during the period of the plague or "black death." In regard to its transmission he wrote: "There can be no doubt that flies feed on the internal secretions of the diseased and dying, then, flying away, they deposit their excretions on the food of neighboring dwellings, and persons who eat of it are thus infected."

Another of the early writers who deserves consideration is a German Jesuit named Kircher (1658.) He discovered bacteria long before Leeuwenhoek, and to these attributed the cause of disease.

Passing to almost modern times we find in 1848 that Dr. Josiah Nott of Mobile, Ala., published a rather remarkable paper on the cause of yellow fever and malaria, yet his work has been greatly overrated and his theories of mosquitoes, aphids and cotton worms as causative agents were used without the significance of modern science.

In 1853 Beauperthuy, a French physician, discussed the role of mosquitoes in transmission of malaria. In regard to Beauperthuy's work Boyce says: "It is Dr. Beauperthuy whom we must regard as the father of the doctrine of insect-borne disease."

A definite and conclusive mass of argument to support the belief of malaria being transmitted by mosquitoes was brought about in 1883 by an American physician, A. F. A. King, and

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about the same time Dr. Finley of Havana, Cuba, presented his facts in regard to mosquito transmission of yellow fever.

To return to the topic of discussion for this evening, we find as intermediate hosts for the malaria plasmodum, three species of Anopholes mosquitoes, namely: A. crucians, purely southern species; A. quadrimaculatus, a species of general distribution; and the third species causing the transmission is A. punctipennis, which is also of general distribution. These mosquitoes are the agents of transmission for a protozoan blood parasite which causes a breaking down of the red blood corpuscles, and produces a condition commonly termed "chills and fever," or malaria. In favorable conditions these fever attacks occur every 48 hours.

Three principal types of the disease are known. They are: 1, the benign-tertian, caused by *Plasmodium vivax,* which completes its cycle of development every 48 hours, producing the feverish condition. This type is wide spread and common; 2, the quartan fever caused by *Plasmodium malaria,* having a cycle of 72 hours and is more prevalent in temperate and tropical regions, but appears rarely everywhere; 3, sub-tertian or pernicious fever caused by *Plasmodium falciparum.* This is an irregular type of fever and the life cycle of the parasite takes place in the internal organs, principally the spleen, instead of in the peripheral circulation.

Being accustomed, as we are, to malaria in this country, little importance do we place upon it, yet if we should look on the mortality side of the question, the facts no doubt appear astounding. In Italy it causes an average annual mortality of 15,000 out of each 2,000,000 cases. In India it claims annually 1,136,000 persons. In 1911 in Alabama 70,000 cases of malaria were known and of this number 770 cases were fatal.

From my personal observation in South America, and also in the Mississippi Delta region, I should say the figures for Alabama are very conservative.

Having briefly passed over a few of the important facts let us turn back to the life cycle of the *Plasmodium vivax* and see the importance of the mosquito in its development.

In the adult stage *Plasmodium vivax* is found living as an amoeboid, intracellular parasite in the red blood corpuscles of man. In the life cycle two well defined stages are noted; Shizogony (fision), and Sporogony (or spore formation).

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This has in a brief way served to illustrate the relation of the mosquito to malaria and so brings us to the second part of the evening's topic, the relation to Agriculture.

Generally speaking, I doubt if this side of the question has scarcely attracted your attention, yet if you stop a moment to consider the enormous losses in crops and waste of uninhabited land due to malaria, the results are amazing.

A beginning along this line was made by Herrick in 1903 when he showed that in the Southern United States the effect of malaria was retarding the development of the country and rendering practically uninhabited some of the most fertile regions of the world, namely, the great Mississippi delta.

A more accurate estimate was made in 1909 when Dr. L. O. Howard placed the annual money loss from malaria in the United States at not less than $100,000,000.

This seemed to cause an awakening of the Bureau of Entomology and as a result Mr. D. L. Van Dine has been stationed for the past few years at Mound, La., and Mr. James K. Thibault, Jr., at Scott, Arkansas. The results of their observations were published in the Southern Medical Journal for March, 1915, and I will briefly give a review of their results.

It is generally known that the Anopheles mosquito larvae thrive best in shallow margins of swamps, ponds, slow moving streams, grass grown springs, and land locked pools, or in other words the abundance of the mosquito in a region is in direct proportion to the extent of water collections.

Malaria, unlike yellow fever, is of rural origin, and decreases in proportion to the decrease of natural collections of surface water; that is as large areas of land have been drained and brought under cultivation, thus destroying the breeding places for the mosquito. Malaria has decreased in direct ratio to the amount of decrease in surface water.

If a map of the United States was made to locate the swamps, undrained lands and lands subject to overflow, you would find that you would also indicate:

(1) Regions known to be malarial;

(2) Areas which include the distribution of one or more species of mosquitoes that transmit malaria;

(3) The most fertile lands in the United States;

(4) Lands which offer the most in crop returns, and are less developed than any agricultural regions of similar extent in the United States.

To show the large amount of acreage that would be included in the above heads I will quote from Senate Document 443, 60th Congress, 1st session. "There are 79,000,000 acres of swamp lands and lands subject ot overflow in the United States, the bulk of which is agricultural land of the greatest potential productiveness. 55,000,000 acres of this land are located within the Southern States, and 24,000,000 acres alone are in the lower Mississippi Valley. These figures do not include 150,000,000 acres of land in the U. S. not classed as swamp land and not subject to overflow, but which are in need of drainage. The larger portion of this immense area also lies in the Southern States."

The place selected for Van Dine's work was the Hecla Plantation, on which the town of Mound, La., is located. This plantation contains 3,500 acres of land; 1,800 acres being in cultivation and 1,700 acres in swamps and timber. The farming is done by negro tenant families, of which there are 74. The crops consist principally of cotton, corn and cowpeas.

The interference of malaria with these tenants amounted to 970 lost days as reported to the physician plus 487 days not reported. This does not include the time lost by persons waiting on the patients, and does not include the cases under 8 years of age. To figure in the amount of time lost by waiting on patients gives a total of 1,842 days lost through malaria. The loss of this labor made an estimated loss in the crop yield for this plantation alone of 487 bales of cotton and 4,035 bushels of corn.

Mr. Thibault's work at Scott, Arkansas, was of very similar nature to Mr. Van Dine's, and the actual time loss and estimated crop loss are in approximately the same ratio, so I will not take up the time to review his results.

BEETLE

O'er folded blooms
On swirls of musk,
The beetle booms adown the glooms
And bumps along the dusk.

(James Whitcomb Riley—The Beetle.)